

## CLAIMS

1. A method for identifying failures in a network, comprising:

5 detecting a port failure in a switch;

identifying one or more MAC addresses associated with the port failure; and

10 sending failure notifications to other ports on the switch that identify the one or more MAC addresses associated with the port failure.

2. A method according to claim 1 including:

15 providing multiple ports on the switch that are each connected to a same network processing device;

identifying when one or more of the multiple ports connected to the network processing device have failed; and

20 sending failure notifications to the other ports in the switch identifying each one of the multiple ports connected to the network processing device that have failed.

3. A method according to claim 2 including:

receiving failure notifications;

25 comparing the MAC address in the failure notifications with MAC adjacencies;

routing around an adjacency when the MAC address in one of the failure notifications matches the adjacency and there are no other MAC addresses associated with the adjacency;

routing around the adjacency when multiple MAC addresses in the failure notifications identify all MAC addresses associated with the adjacency; and

30 routing packets to a second MAC address associated with the adjacency when a first MAC address associated with the adjacency is identified in one of the failure notifications.

5           4.     A method according to claim 1 including sending the failure notifications  
using a Cisco Discovery Protocol.

          5.     A method according to claim 1 including sending the failure notifications  
using an Address Resolution Protocol (ARP) reply.

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          6.     A method according to claim 5 wherein the ARP reply causes a receiving  
network processing device to send out an ARP request for the MAC address in the ARP reply  
and to route around an adjacency associated with the MAC address when no ARP reply is  
received in response to the ARP request.

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          7.     A method according to claim 5 including sending in the ARP reply any  
combination of a null IP address, a null MAC address, or a zero hold time value.

          8.     A method according to claim 1 including using a heartbeat signal to detect the  
port failure.

          9.     A method according to claim 1 including configuring the switch to send the  
failure notifications only to the ports in the switch coupled to routers or other switches.

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          10.    A switch, comprising:  
  
                  multiple ports that monitor for a communication failure with connected  
network processing devices; and

5 a processor that sends a failure notification out through the multiple ports  
when the communication failure is detected on one of the multiple ports.

11. A switch according to claim 10 including a table that includes MAC addresses  
associated with the multiple ports, the processor including in the failure notification the MAC  
10 address in the table associated with the port detecting the communication failure.

12. A switch according to claim 10 including a port configuration table that  
identifies which ports the processor sends the failure notification.

13. A switch according to claim 10 wherein the multiple ports use a layer 1  
network protocol to detect the communication failure.

14. A switch according to claim 13 wherein the layer 1 network protocol uses a  
heartbeat signal or a loss-of-light detector to detect the communication failure.

15. A switch according to claim 10 including multiple ports on the switch  
connected to a first network processing device, the processor sending a separate failure  
notification for each one of the ports connected to the first network processing device  
detecting a failure.

16. A switch according to claim 10 wherein the switch operates at layer 2 of an  
OSI model and the network processing devices operate at layer 3 of the OSI model.

5 17. A switch according to claim 10 wherein the processor sends the failure

notification in an Address Resolution Protocol reply message that includes a MAC address  
associated with the port detecting the communication failure and a zero hold time.

18. A switch according to claim 10 wherein the switch is an Ethernet switch for

10 coupling to multiple routers.

19. A switch according to claim 18 including ports on the switch for coupling to  
personal computers over a VLAN connection.

20. Computer code stored on a computer readable medium for identifying failures  
in a network the computer readable medium, comprising:

code adapted to detect a port failure in a switch;

code adapted to identify one or more MAC addresses associated with the port failure;

and

code adapted to send failure notifications to other ports on the switch that identify the  
MAC addresses associated with the port failure.

21. A computer readable medium according to claim 20 including:

code adapted to identify when multiple ports connected to the network processing

25 device have failed; and

code adapted to send failure notifications to the other ports in the switch identifying  
each one of the multiple ports that have failed.

22. A computer readable medium according to claim 21 including:

code adapted to receive failure notifications;

code adapted to compare the MAC address in the failure notifications with MAC

adjacencies;

code adapted to route around an adjacency when the MAC address in one of the

failure notifications matches the adjacency and there are no other MAC addresses associated with the adjacency;

code adapted to route around an adjacency when multiple MAC addresses in the failure notifications identify all MAC addresses associated with the adjacency; and

code adapted to route packets to a different MAC address associated with the adjacency when the MAC address in the failure notifications is associated with the adjacency.

23. A computer readable medium according to claim 21 including code adapted to send the failure notifications using a Cisco Discovery Protocol.

24. A computer readable medium according to claim 21 including code adapted to send the failure notifications using an Address Resolution Protocol (ARP) reply.

25. A computer readable medium according to claim 24 including code adapted to generate the ARP reply so that a receiving network processing element will send out an ARP request for the MAC address in the ARP reply and route around the adjacency associated with the MAC address when no ARP reply is received in response to the ARP request.

5           26.     A computer readable medium according to claim 24 including code adapted to  
send in the ARP reply any combination of a null IP address, a null MAC address, or a zero  
hold time value.

          27.     A computer readable medium according to claim 21 including code adapted to  
10    use a heartbeat signal to identify a port failure.

          28.     A computer readable medium according to claim 21 including code adapted to  
configure the switch to send the failure notifications only to the ports in the switch coupled to  
routers or other switches.

          29.     A system for identifying failures in a network, comprising:  
means for detecting a port failure in a switch;  
means for identifying one or more MAC addresses associated with the port failure;  
and  
means for send failure notifications to other ports on the switch that identify the MAC  
addresses associated with the port failure.

          30.     A system according to claim 29 including:  
20    means for identifying when multiple ports connected to the network processing device  
have failed; and  
means for sending separate failure notifications to the other ports in the switch  
identifying each one of the multiple ports connected to the network processing device that  
have failed.

31. A system according to claim 30 including:

means for receiving failure notifications;

means for comparing the MAC address in the failure notifications with MAC  
adjacencies;

means for routing around an adjacency when the MAC address in one of the failure  
notifications matches the adjacency and there are no other MAC addresses associated with  
the adjacency;

means for routing around the adjacency when multiple MAC addresses in the failure  
notifications identify all MAC addresses associated with the adjacency; and

means for routing packets to a different MAC address associated with the adjacency  
when the MAC address in the failure notifications is associated with the adjacency.

32. A system according to claim 29 including means for sending the failure  
notifications using a Cisco Discovery Protocol.

33. A system according to claim 29 including means for sending the failure  
notifications using an Address Resolution Protocol (ARP) reply.

34. A system according to claim 33 including means for generating the ARP reply  
so that a receiving network processing element will send out an ARP request for the MAC  
address in the ARP reply and route around the adjacency associated with the MAC address  
when no ARP reply is received in response to the ARP request.

35. A system according to claim 33 including means for sending in the ARP reply any combination of a null IP address, a null MAC address, or a zero hold time value.

36. A system according to claim 29 including means for using a heartbeat signal to identify a port failure.

37. A system according to claim 29 including means for configuring the switch to send the failure notification only to the ports in the switch coupled to routers or other switches.

38. A network processing device, comprising:

one or more ports for communicating and receiving failure notifications from a

switch, the failure notifications including a MAC address associated with a port on the switch that has failed; and

a processor that reroutes around an adjacent network processing device on the switch associated with the MAC address in the failure notification.

39. A network processing device according to claim 38 including an adjacency table that identifies MAC addresses for adjacent network processing devices connected to the switch, the processor routing around any MAC address in the adjacency table matching the MAC address in the failure notification.

40. A network processing device according to claim 38 wherein the failure notification is received via an Address Resolution Protocol (ARP) reply, the processor



5 sending out an ARP request for the MAC address contained in the ARP reply and rerouting  
around the adjacent network processing device associated with the MAC address when no  
ARP response is received responsive to the ARP request.

10 41. A network processing device according to claim 38 wherein an adjacent  
network processing device has multiple ports coupled to the switch, the processor routing  
around the adjacent network processing device only when the failure notifications identify  
failures on all of the ports on the switch coupled to the adjacent network processing device.

42. A method for fast failure detection, comprising:  
receiving a failure notification from a switch, the failure notification including a MAC  
address associated with a port on the switch that has failed; and  
routing around an adjacent network processing device associated with the MAC  
address in the failure notification.

20 43. A method according to claim 42 including:  
receiving the failure notification via an Address Resolution Protocol (ARP) reply;  
sending out an ARP request for the MAC address contained in the ARP reply; and  
routing around an adjacent network processing device associated with the MAC  
address when no ARP response is received for the ARP request.

25 44. A method according to claim 42 including:  
identifying an adjacent network processing device having multiple ports coupled to  
the switch; and

5 routing around the adjacent network processing device when the failure notification identifies failures on all of the ports on the switch coupled to the adjacent network processing device.

45. Computer code stored on a computer readable medium for identifying failures  
10 in a network, comprising:

code adapted to receive failure notifications from a switch, the failure notification including a MAC address associated with a port on the switch that has failed; and

code adapted to route around an adjacent network processing device associated with the MAC address in the failure notification.

46. A computer readable medium according to claim 45 including:

code adapted to receive the failure notification via an Address Resolution Protocol (ARP) reply;

code adapted to send out an ARP request for the MAC address contained in the ARP  
20 reply; and

code adapted to route around an adjacent network processing device associated with the MAC address when no ARP response is received for the ARP request.

47. A computer readable medium according to claim 46 including:

25 code adapted to identify an adjacent network processing device having multiple ports coupled to the switch; and

5 code adapted to route around the adjacent network processing device when the failure notification identifies failures on all of the ports on the switch coupled to the adjacent network processing device.

10 48. A system for identifying failures in a network, comprising:  
means for receiving a failure notification from a switch, the failure notification including a MAC address associated with a port on the switch that has failed; and  
means for routing around an adjacent network processing device associated with the MAC address in the failure notification.

49. A system according to claim 48 including:  
means for receiving the failure notification via an Address Resolution Protocol (ARP) reply;  
means for sending out an ARP request for the MAC address contained in the ARP reply; and  
20 means for routing around an adjacent network processing device associated with the MAC address when no ARP response is received for the ARP request.

50. A system according to claim 48 including:  
means for identifying an adjacent network processing device having multiple ports  
25 coupled to the switch; and  
means for routing around the adjacent network processing device when the failure notification identifies failures on all of the ports on the switch coupled to the adjacent network processing device.